incorporate the same encoding moiety at the same amount or concentration. A population of beads may be similar in that the beads in the population have the same probe coupled thereto. Beads from different populations may be pooled to create a mixed population. Note that in a situation in which beads from different populations are coupled to different probes or incorporate different detectable moieties, not all beads in a particular population need be coupled to the probe or incorporate the moiety. For example, as is well known to one of ordinary skill in the art, coupling reactions are less than 100% efficient. It is sufficient that a significant number of beads in a first population exhibit the characteristic that defines that population while not exhibiting the characteristic(s) that define other populations with which the first population is to be mixed.

[0046] Probe or sensor: An entity that can indicate the presence and/or abundance of a molecule of interest (a target or analyte) or can indicate the occurrence of a chemical reaction or a molecular interaction of interest. The indication may include reversible or irreversible binding of the target to the probe, although this need not be the case. The probe may itself be detectable or may be modified to be detectable, though this need not be the case. In general, the purpose of a probe is to allow detection of the presence or abundance of a target molecule or to allow detection of the occurrence of a chemical reaction or molecular interaction. Therefore, the combined presence of probe and target, or the occurrence of the chemical reaction or molecular interaction in the presence of the probe should ultimately result in a detectable readout. Probes include nucleic acid molecules, proteins (including antibodies and enzymes), aptamers, modified nucleic acids, modified proteins, etc. For example, an appropriate probe for indication of the presence of a target single-stranded nucleic acid molecule having a particular sequence would be a substantially complementary single-stranded nucleic acid molecule able to hybridize with the target.

[0047] Sample: A sample is any material that may contain a molecule or molecule(s) of interest. For example, a sample obtained from a subject may include, but is not limited to, any or all of the following: a cell or cells, a portion of tissue, blood, serum, ascites, urine, saliva, and other body fluids, secretions, or excretions. The term "sample" also includes any material derived by processing such a sample. Derived samples may include cell extracts or lysates, nucleic acids or proteins extracted from the sample or obtained by subjecting the sample to techniques such as amplification or reverse transcription of mRNA, etc. A sample may comprise material obtained from the environment, e.g., air, water, soil, or derived by processing such a sample. A sample may comprise natural or synthetic compounds, including but not limited to products of bacterial metabolism, synthesized organic molecules such as combinatorial chemical libraries, etc.

[0048] Substrate: A substrate, or solid support, as used herein refers to any material that contains or provides, or can be modified to contain or provide, locations for array elements. In the context of the present invention, an appropriate substrate is generally a material that contains or can be modified to contain, magnetic material regions, either as part of the substrate or added to it. Generally the substrate is planar, though this need not be the case. Generally the substrate has sufficient strength and hardness to allow routine laboratory handling. Examples of substrates include, but are not limited to, silicon or silicon-based materials, glass and modified or functionalized glass, plastics and modified or functionalized plastics, (including acrylics, polystyrene, polypropylene, polyethylene, etc.), metals, and ceramics. The substrate can have or lack magnetic properties.

[0049] Target: A material or entity whose presence and/or abundance is to be detected or whose identity is to be determined by an assay. A target may interact either directly or indirectly with a probe. Such interaction may include reversible or irreversible binding or association. A target may be a nucleic acid molecule, a protein, carbohydrate, lipid, receptor ligand, antigen, a small organic molecule, etc. Without intending to be limiting, a target nucleic acid sequence may be, a gene, a portion of a gene, a regulatory sequence, DNA, RNA, mRNA, cDNA, etc. For example, a target may be a single-stranded nucleic acid molecule including a genomic region that has been found to contain a single nucleotide polymorphism. A target may be contained within a portion of a larger molecule, and multiple target domains may exist within a single molecule.

DETAILED DESCRIPTION

[0050] I. Overview

[0051] The present invention encompasses the realization that randomly ordered micoarrays offer significant advantages in terms of flexibility, simplicity of fabrication, statistical robustness, and high throughput. The invention provides a device containing magnetic regions or domains and methods of using the device to generate randomly ordered arrays of magnetic particles. The invention further provides arrays formed using the device and methods of using the arrays, e.g., for detection of molecules of interest. The device of the present invention may be referred to herein as a magnetic chip. In one embodiment, the invention employs magnetic beads, which are dispersed onto the surface of the chip, forming array elements. The magnetic domains generate localized magnetic fields that facilitate reversible yet robust attachment of the magnetic beads to the chip and constrain their location. According to the invention, probes are attached to individual beads, which are then distributed randomly on the chip, forming array elements. The beads are magnetically coupled to the chip. In certain embodiments of the invention the arraying can be performed simply by dispensing a bead solution onto the chip (e.g., using a pipette), or by employing a gentle fluid flow.

[0052] The locations at which a bead may attach to the chip are largely determined by the configuration and features of the magnetic domains and of the gap regions between the magnetic domains. Such features include, among others, the dimensions of the magnetic domains and gap regions, the structure of the magnetic domains, and the spatial relationships between the magnetic domains and gap regions. Thus the potential locations of the beads are in large part a